



Plan Deconfliction, Repair, and Authoring in EDSS FY02 In Process Review



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Our Focus

Prototype modules for future versions of EDSS



Project Outline

Stage 1: Automated Conflict Detection and Reporting

- FY02: Plan Deconfliction (PD) Module

Stage 2: Plan Analysis and Modification Suggestions

- FY03: Module for suggesting (post-hoc) how to avoid constraint violations

Stage 3: Dynamic Re-Planning

- FY03 (UM): Run-time reaction to constraint violations

Stage 4: Plan Expertise Sharing

- FY04: Plan authoring/sharing capabilities

Presentation Outline

1. FY02 Goals/Approach

- Domain familiarization
- Computing environment
- Constraint specification
- Simulation Data
- Plan Deconfliction (PD) Module
 - Batch
 - Incremental
- Testing
- Progress Reports

2. FY02 Progress

- PD v1.0 (batch)
- Demonstration (Scott Stewart)
- Issue discussion

3. Future Goals (FY03-FY04)

Domain Familiarization

Reading materials:

- NWP 3-02.1 ("Ship to Shore Movement") (282 pages, 8/94)
- CPG3 message 041605Z (2 pages; 10/99)
- EDSS User's Guide (64 pages, 1/02)
- Draft MNS for A Distributed Collaborative Planning (DCP) System for Expeditionary Forces (4 pages; 10/99)
- *Marine: A Guided Tour of a MEU* (T. Clancy, 1996, Berkley Books)

Personnel:

- SME: Glenn Palmer (Focus: Constraint specs)
- SAIC: Shawn Faust (Focus: Software/Hardware)

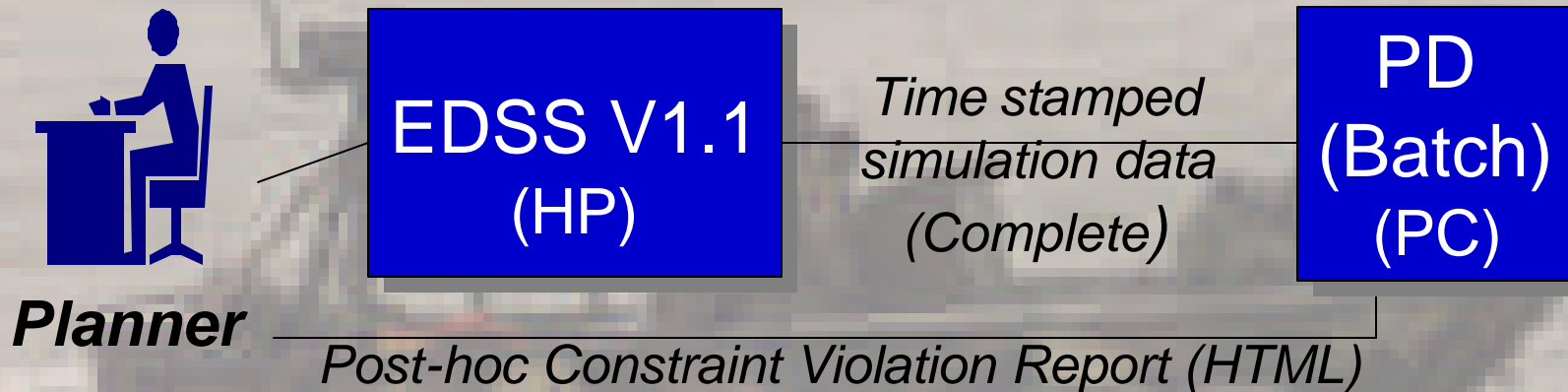
Computing Environment

Recommended “low-end” option (from S.F.):

- HP 712/100, HPUX 10.20 OpSys, 192M, 18GB, 1yr warranty
- \$530

Suffices during FY02 to run EDSS v1.1

Current Integration



Integration: Formatted Text File I/O

SAIC (S.F.): Modified EDSS to output simulation data



Output Format for EDSS Plan Deconfliction Model

(Shawn Faust)



Number of Waves (1-100)

For each wave:

Craft/Wave Name (character string up to 20 characters)

Craft Name (AAV, LCU, LCAC, etc.)

Beach Center (position of beach center or -99 -99 for none)

Number of Routes (integer from 1-10)

For each route:

Route Name (character string up to 7 characters)

Width of route

Number of points (integer from 1-130)

For each point

Latitude Longitude (floating point degrees)

EDSS will write the following after each simulated minute:

For each craft currently in transit:

Time Stamp (DTG time, Zulu time zone)

Craft/Wave Name

Craft Type (0 = Surface Ship; 1 = Fixed Wing Air; 2 = Rotary Air; 3 = Land)

Craft Name (AAV, LCU, LCAC, CH-46, etc.)

Latitude Longitude (floating point degrees)

Speed (floating point number greater than 0)

Course (floating point degrees between 0.0 and 359.9)



Constraint Specification

(compiled with help from Glenn Palmer)



Factor	Sub-Factor	Constraint
Channel	Boat Lanes	None (for now)
Ship Proximity	Approach Lanes	
	Location Angle	Front (315°-45°): 1000yds Side (45°-315° & (225°-315°): 500yds Astern (135°-225°): 300yds
Air Proximity	Fixed-Wing	1000ft
	Rotary	500ft
	Fixed/Rotary	1000ft
Displacement	Time	<i>N</i> minutes minimum between final AAV to reach beach and first LCAC/LCU crosses boat lane's line of departure (LOD)
	Distance	500yds min between LCAC and conventional beaches
		500yds min between any LCAC/LCU and any other LCAC/LCU
Visibility	Night/Day	Double all proximity constraint distances in night situations
	Fog/Clear	Double all proximity constraint distances in foggy situations

Example/Test Simulations

Two (unclassified) EDSS plans: (from G.P.)

1. "Simplistic"

- East coast, 1 LCU, 1 LCAC, 1 AAV approaching 1 beach

2. "Masterpiece"

- 2 beaches
- 2 sets of AAVs
- Trek across land
- Helos
- UAV
- Ships (~7): LCACs, LCUs, etc.

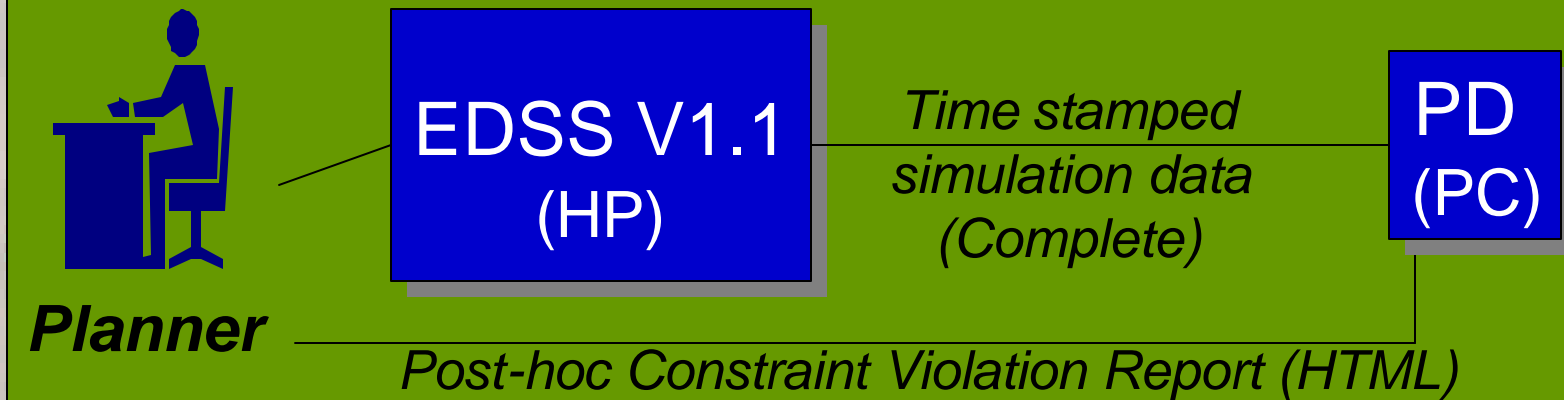
Use:

- Ported to EDSS v1.1
- Used to output time stamped files for analysis by PD module

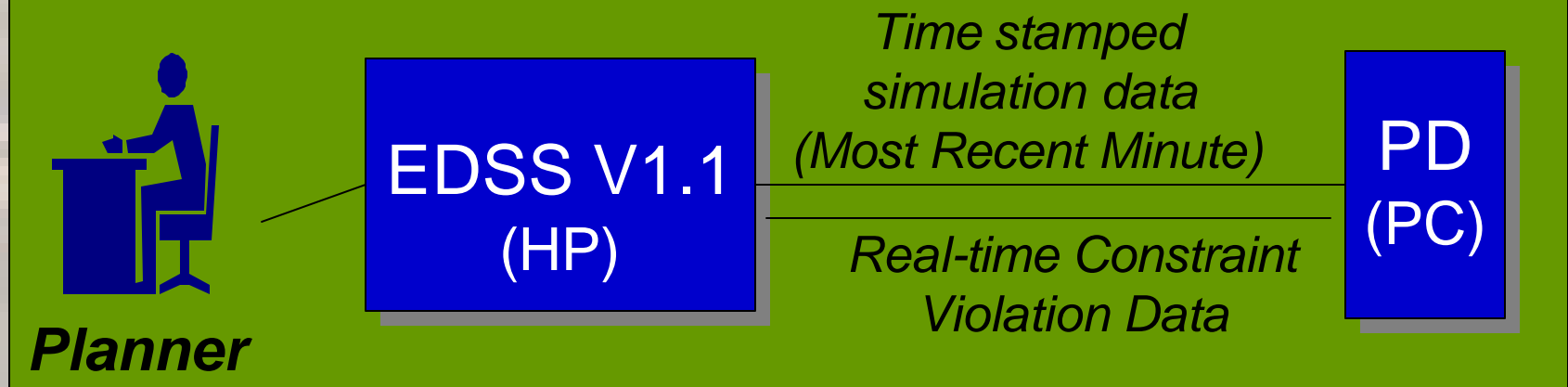
Plan Deconfliction (PD) Module

(Java 2.0)

Batch Version



Incremental Version



Testing

Initially chosen measures

- Dependent variables
 - Precision ($\frac{\text{\#conflicts_detected}}{\text{\#detections}}$)
 - Recall ($\frac{\text{\#conflicts_detected}}{\text{\#conflicts}}$)
 - Detection speed (vs. human planners)
 - Reporting format (e.g., comprehensibility, interface)
- Independent variables
 - Planning characteristics (e.g., #ships involved, #beaches)

Goal: 100% precision

Types of Tests:

1. In-house: Requires specifying a space of plans to automatically generate and test
2. EDSS Users: (a) SME (b) Operational personnel
 - Goal is to participate in EDSS-selected exercise when the software is deemed sufficiently mature



U. Maryland Sub-Contract



Was delayed

- Proposal submitted in March
- Awarded in April, although NRL groups lacked communication
- Notified U.M. in May

FY02-FY03 Focus: Dynamic Re-Planning

- Goal: When impending constraint violations are expected, system will respond by modifying the plan
- Requires constraints to identify feasible modifications
- May require ontology to reason about the constraints
- Potential Approach: Constraint-based extension of U.M.'s previous work on hierarchical task network (HTN) planning

Personnel:

- Professor Dana Nau (Computer Science, Manufacturing)
- Ph.D. student (dissertation focus: temporal planning)

Progress Reports

Corresponding to milestones

1. 6/12/02: After first SME interview
2. After FY02 In Process Review
 - PD v1.0
 - Feedback from In Process Review
3. After processing 2nd set of constraints
 - PD v1.1
 - Proposed user testing process
4. End of FY02
 - Status of PD: Accomplishments, unresolved issues
 - Future directions
 - Code documentation: Summary

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Progress to Date

1. Domain familiarization
2. GCCS-M/EDSS v1.1 running at NRL
3. First iteration of constraints acquired from SME
4. Example EDSS plans acquired from SME
5. PD module developed
 - v1.0
 - Processes initial set of conflicts
 - Initial demonstration (on plans provided by SME)
6. U.Maryland sub-contract in place

Demonstration

(Scott Stewart, 3/02-6/02)

Outline:

1. Software design description
2. Simulation review ("Masterpiece" plan)
3. Simulation output files
4. PD v1.0 review
 - HTML constraint violation report (post-hoc)

Issues: Discussion (FY02)

1. Report format: Requesting feedback

2. Incremental version of EDSS: Next focus?

3. Astronomical data: (automatically compute)

- Times:
 - Sun: Rise/set
 - Nautical twilight (45min prior to sunrise, and 45min after sunset)
 - Moon: Rise/set
 - Tides: High/low
- Tides: Heights
- Moon: % illumination
- Magnetic variation

4. Next iteration of constraint violations

5. Constraint editor?

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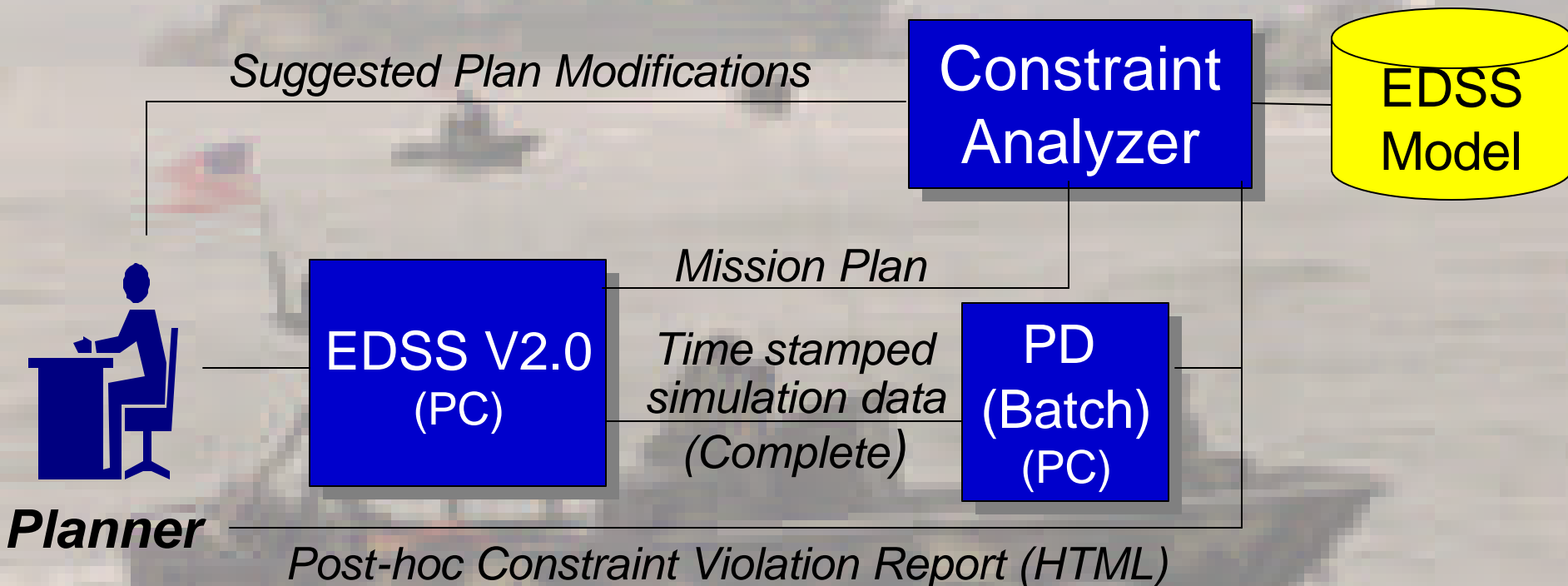
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Stage 2: Plan Analysis and Modification Suggestions

(FY03)



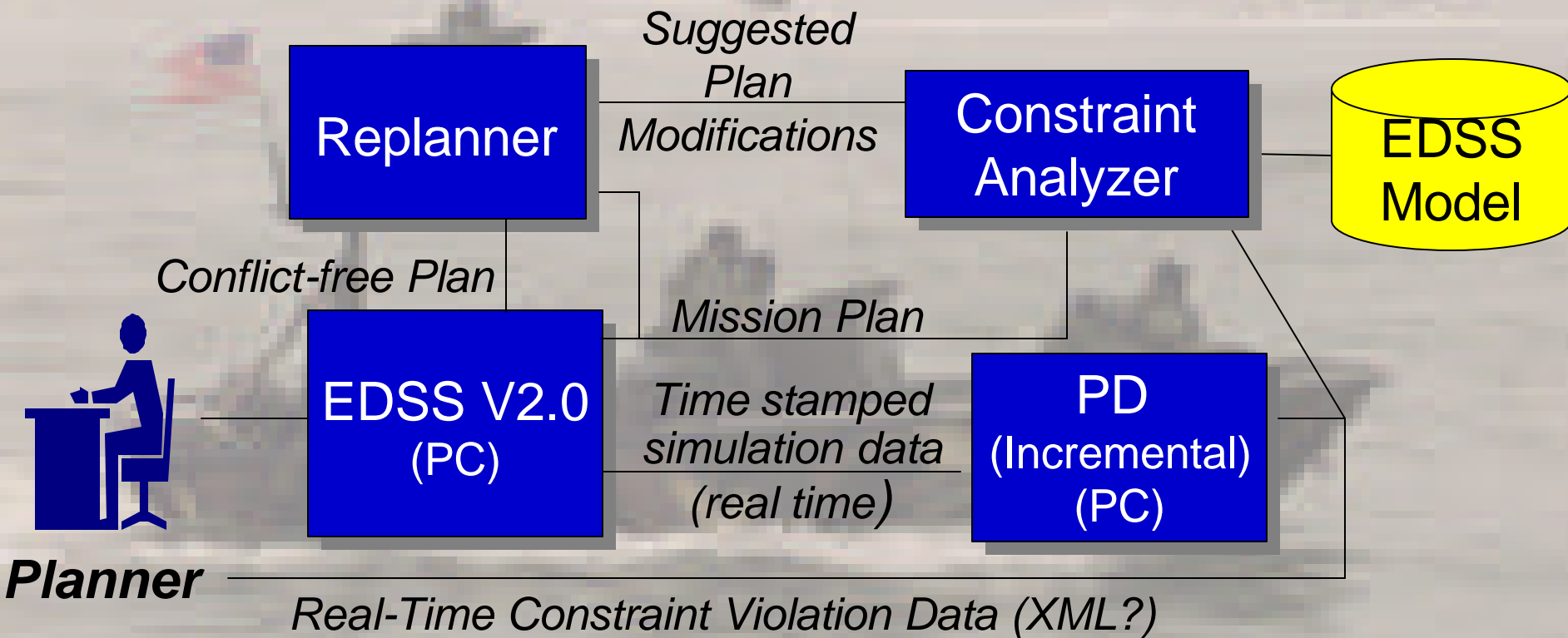
Risk notes

- EDSS model: moderate risk (not low)
- Automated modules for recommending plan modifications: rare

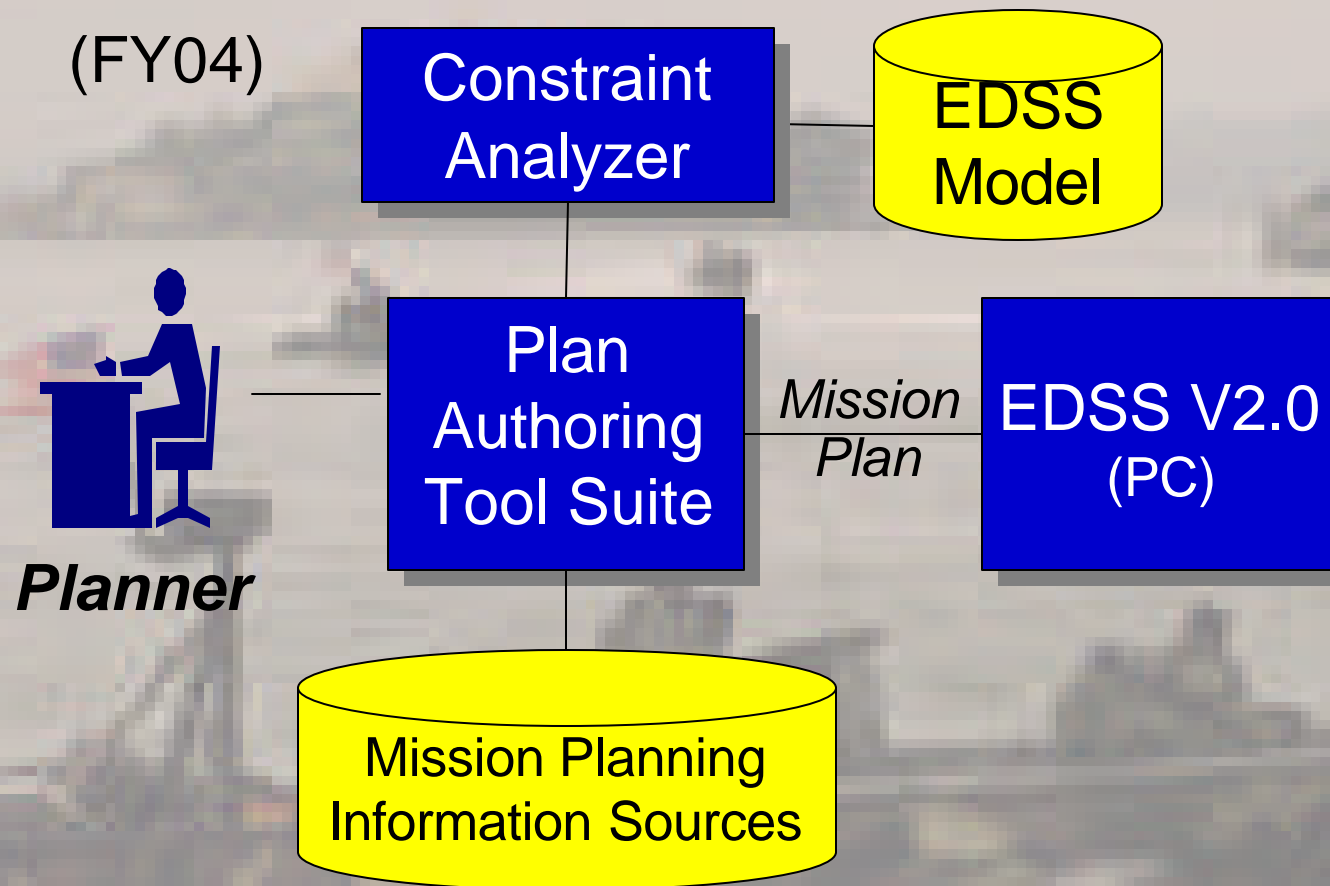
Stage 3: Dynamic Re-Planning

(FY03)

Discussed on slide 11 (Lead: U.Maryland)



Stage 4: Plan Expertise Sharing



Potential benefits

- Sharing of plans and associated decisions (promoting reuse)
- Shift some burden of plan authoring to associated tools
- Detect probable constraint violations prior to simulation

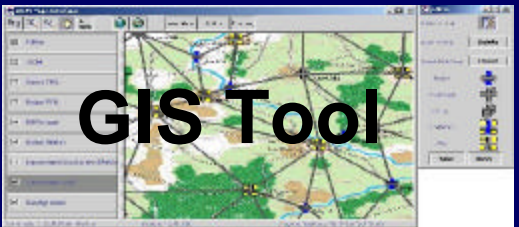
IPATS: Integrated Plan Authoring Tool Suite

Objective: Reduce (Operational/Tactical) Planning Time



Planning GUIs

Temporal Plan Editor (DARPA/GD)



GIS Tool

HICAP: Inferencing/KM Tools

NaCoDAE: Interactive Task Decomposer

SHOP: Automated Task Decomposer

ALDS: Proactive Lesson Distributor

LET: Guided Lesson Elicitation

Restated Mission
CDR's Intent
Intel Estimate



COA
Plan

Applications:

1. NEOs
2. Crisis Planning
3. Wargaming
4. SOF DA Missions



Questions?



Program: Accelerated Amphibious Planning

Project: Plan Deconfliction, Repair, and Authoring in EDSS

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